

Probabilistic Remaining Useful Life Prediction of Composite Aircraft Components, Phase II

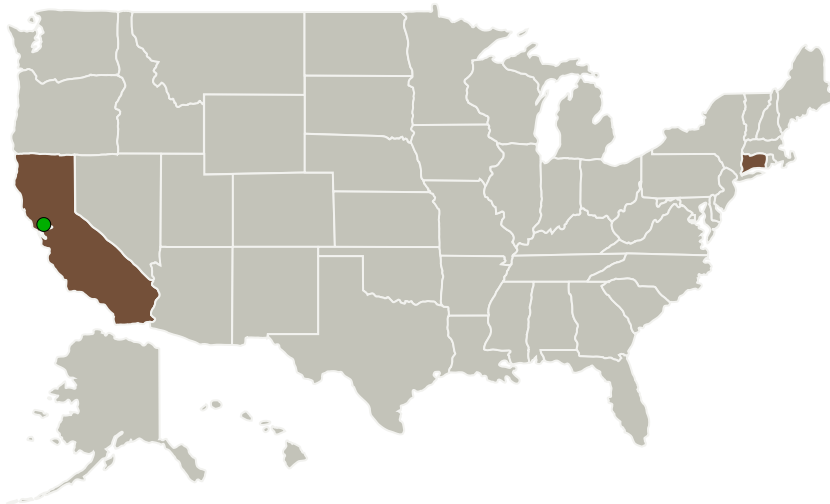
Completed Technology Project (2012 - 2014)



Project Introduction

A Probabilistic Fatigue Damage Assessment Network (PFDAN) toolkit for Abaqus will be developed for probabilistic life management of a laminated composite structure with both microcracking induced stiffness degradation and cyclic loading induced delamination crack growth without remeshing. It is based on a high fidelity Fatigue Damage Assessment Network (FDAN) which includes 1) a coupled continuum damage and discrete crack model for ply damage characterization; 2) a moment schema finite element coupled with XFEM for efficient crack growth simulation in a thin ply; 3) a mixed mode fatigue delamination module to account for the mode mixity and failure mode interaction; and 4) an adaptive fracture process zone model for mesh independent delamination growth. A reduced-order model of FDAN will be generated using a combined response surface and a Gaussian process surrogate model builder to perform the subsequent probabilistic analysis efficiently. For the module verification and validation, experimental studies at the sub-component level will be performed along with the use of a damage monitoring and characterization system. The developed toolkit will be used to perform damage prognosis and risk informed life management using SHM data. GEM has secured commitments for technical support and commercialization assistance from Clarkson University, Sikorsky Aircraft, and Boeing.

Primary U.S. Work Locations and Key Partners



Probabilistic Remaining Useful Life Prediction of Composite Aircraft Components

Table of Contents

Project Introduction	1
Primary U.S. Work Locations and Key Partners	1
Project Transitions	2
Images	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	3
Technology Areas	3
Target Destinations	3

Probabilistic Remaining Useful Life Prediction of Composite Aircraft Components, Phase II

Completed Technology Project (2012 - 2014)



Organizations Performing Work	Role	Type	Location
Global Engineering and Materials, Inc	Lead Organization	Industry	East Lyme, Connecticut
● Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations	
California	Connecticut

Project Transitions

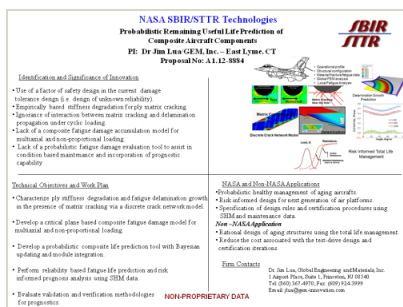
May 2012: Project Start

May 2014: Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/138426>)

Images



Project Image

Probabilistic Remaining Useful Life Prediction of Composite Aircraft Components
(<https://techport.nasa.gov/image/134539>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Global Engineering and Materials, Inc

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torre

Principal Investigator:

Yuanjie Lua

Co-Investigator:

Jim Lua

Probabilistic Remaining Useful Life Prediction of Composite Aircraft Components, Phase II

Completed Technology Project (2012 - 2014)



Technology Maturity (TRL)

Start: **4**
Current: **6**
Estimated End: **6**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
 - └ TX12.2 Structures
 - └ TX12.2.4 Tests, Tools and Methods

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System